Curriculum
(Scheme of Instruction & Evaluation and Course contents)

For
Two Year Postgraduate Programme Leading to
Master of Technology (M.Tech.) Degree in
Civil Engineering with specialization in Construction Management

Implemented from the batch admitted in Academic Year 2014-15
VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE

(Autonomous Institute affiliated to University of Mumbai)

Curriculum
(Scheme of Instruction & Evaluation and Course contents)

For
Two Year Postgraduate Programme Leading to
Master of Technology (M.Tech.)
In

203 Civil Engineering (with Specialization in Construction Management)
CIVIL AND ENVIRONMENTAL ENGINEERING DEPARTMENT

Scheme and Syllabus for

M.Tech. (Civil Engineering) with specialization in Construction Management

Programme Educational Objectives (PEOs)

<table>
<thead>
<tr>
<th>PEO1</th>
<th>Develop advanced competencies in construction methodologies and their selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEO2</td>
<td>Develop entrepreneurial, managerial and leadership skills to perform as a professional construction manager</td>
</tr>
<tr>
<td>PEO3</td>
<td>Expand career potential of individuals through applied learning experiences and analytical skills using conventional and modern ICT tools in the area of construction and its management</td>
</tr>
</tbody>
</table>

Programme Outcomes (POs)

<table>
<thead>
<tr>
<th>PO1</th>
<th>Ability to evaluate and gauge appropriateness of construction technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO2</td>
<td>Ability to critically analyse engineering problems to facilitate theoretical and practical research</td>
</tr>
<tr>
<td>PO3</td>
<td>Ability to foresee &amp; formulate problems and select and apply appropriate problem solving approach</td>
</tr>
<tr>
<td>PO4</td>
<td>Ability to use systems approach to formulate, analyse and seek solutions to relevant problems</td>
</tr>
<tr>
<td>PO5</td>
<td>Ability to harness ICT tools including prediction and modelling</td>
</tr>
<tr>
<td>PO6</td>
<td>Ability to lead multidisciplinary teams.</td>
</tr>
<tr>
<td>PO7</td>
<td>Understanding of management principles with the consideration of social, economical and financial aspects</td>
</tr>
<tr>
<td>PO8</td>
<td>Skill for listening and communicating convincingly</td>
</tr>
<tr>
<td>PO9</td>
<td>Ability to lifelong learning technological advances in construction technologies and management methodologies.</td>
</tr>
<tr>
<td>PO10</td>
<td>Understanding of professional and ethical responsibility</td>
</tr>
<tr>
<td>PO11</td>
<td>Ability to critically evaluate own actions for making continuous improvements in one’s own performance</td>
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Scheme of Instructions and Evaluation
### Semester I

<table>
<thead>
<tr>
<th>SN</th>
<th>Course Code</th>
<th>Course Title</th>
<th>L-T-P (Hours/Week)</th>
<th>Credit</th>
<th>TA</th>
<th>IST</th>
<th>ESE</th>
<th>ESE hours</th>
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<tbody>
<tr>
<td>1</td>
<td>CE5001S</td>
<td>Computational Methods</td>
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<td>2</td>
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Total 27 24
## Semester II

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<th>SN</th>
<th>Course Code</th>
<th>Course Title</th>
<th>L-T-P (Hours/Week)</th>
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<th>IST</th>
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<th>ESE hours</th>
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<tr>
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Abbreviations: **L**: Lecture, **T**: Tutorial, **P**: Practical, **TA**: Teacher Assessment / Term work Assessment, **IST**: In Semester Tests (comprise of average of two In semester tests), **ESE**: End Semester Written Examination, **CIE**: Continuous In-semester Evaluation

## Semester III
<table>
<thead>
<tr>
<th>SN</th>
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<th>Course Title</th>
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<th>IST</th>
<th>ESE</th>
<th>ESE hours</th>
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**Semester IV**

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### List of Programme Elective Course I

<table>
<thead>
<tr>
<th>SN</th>
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<tbody>
<tr>
<td>1</td>
<td>CE5101S</td>
<td>Risk &amp; Value Management</td>
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<tr>
<td>2</td>
<td>CE5102S</td>
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<td>4</td>
<td>CE5103S</td>
<td>EIA and Audit</td>
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<td>CE5104S</td>
<td>Environmental Management</td>
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### List of Programme Elective Course II

<table>
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<tbody>
<tr>
<td>1</td>
<td>CE5105S</td>
<td>Rehabilitation of Structures</td>
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<tr>
<td>2</td>
<td>CE5106S</td>
<td>Energy conservation in facility design &amp; construction</td>
</tr>
<tr>
<td>3</td>
<td>CE5107S</td>
<td>Operational Health &amp; Safety management</td>
</tr>
<tr>
<td>4</td>
<td>CE5108S</td>
<td>Construction Entrepreneurship</td>
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### List of Programme Elective Course III

<table>
<thead>
<tr>
<th>SN</th>
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<th>Program Elective Course</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>CE5109S</td>
<td>Integrated GIS &amp; GPS in Infrastructure</td>
</tr>
<tr>
<td>2</td>
<td>CE5110S</td>
<td>Water Resource management</td>
</tr>
<tr>
<td>3</td>
<td>CE5111S</td>
<td>Construction management information systems</td>
</tr>
<tr>
<td>4</td>
<td>CE5112S</td>
<td>Facilities management</td>
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### List of Programme Elective Course IV

<table>
<thead>
<tr>
<th>SN</th>
<th>Course Code</th>
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<tbody>
<tr>
<td>1</td>
<td>CE5113S</td>
<td>Quality Assurance on Construction Projects</td>
</tr>
<tr>
<td>2</td>
<td>CE5114S</td>
<td>Pavement Management System</td>
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<tr>
<td>3</td>
<td>CE5115S</td>
<td>Sustainable building construction</td>
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<tr>
<td>4</td>
<td>CE5116S</td>
<td>International Construction Business</td>
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<tr>
<td>Course Code</td>
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<tr>
<td>CE5001S</td>
<td>Computational Methods</td>
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</table>

**Course Outcomes:**
- CO1. To understand different mathematical modeling strategies to simulate civil engineering systems.
- CO2. To understand different computational techniques to analyze mathematical models
- CO3. To develop computational skills to solve problems in the field of civil engineering
- CO4. To develop ability to identify and define civil engineering problems, to gather data related to the problem, to select and implement the appropriate solution.

**Mathematical Model**
- Model, Purpose of modeling, Types of model, Steps in modelling process - Problem definition, Purpose definition, Conceptualization, Selection computer code, Model design, Calibration, Validation.
- Errors in engineering calculations (sources of errors, significant digits, rounding off, propagation of maximum error, propagation of variance, bias & precision).

**Interpolation and Extrapolation**
- Langrange’s Interpolation, Newton’s Interpolation - Forward, Backward, Hermite Interpolation,
- Spline Interpolation - cubic, inverse interpolation, Extrapolation, Civil Engineering Application - elevation contour map, isohyetal map, Noise Map, etc.

**Numerical Differentiation and Numerical Integration**
- Newton Raphson method, Modified Newton Raphson method and successive approximation method.
- Trapezoidal rule, Simpson’s rule (⅓ rd, ⅔ th), Gauss quadrature method 2-point, 3-point, Double integration-
- Civil Engineering Application - Earthwork volume estimation, Estimation of pile capacity etc.

**Curve Fitting and Errors**
- Curve fitting (Interpolation, function that fits given values - approximate and exact, find function where reaches min/max or a specific value, linear regression, higher order polynomial, Gaussian, quantifying errors in curve fitting) Civil Engineering Application - Population Forecasting Methods, Reduction Rate Parameters for design of Treatment Units, atmospheric dispersion of pollutant (Gaussian Dispersion Model), Dispersion at sea outfall, etc.
- Finite difference and finite element method
- Finite Element Method (limited to 1D elements): Basic understanding of finite element method including elements types and their formulation, Civil Engineering Application - Groundwater modelling, Flood routing, Self Purification of Streams (Streeter Phelps Equation), Finite element
Method of Solution of Differential Equations (Some Basic ODEs, Higher order ODEs), O.D.Es with special Types, Numerical solution techniques, Applications in Real Life problems, Quality Assurance in Engineering and construction, and Optimization

Optimization
Concept of optimization, Linear programming , Civil Engineering, Environmental Engineering, Water resources engineering, and Structural engineering Applications

<table>
<thead>
<tr>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Numerical methods for Engineers, Chapra, S.C and Canale, R .P., Mcgraw hill Intl., 2012</td>
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<tr>
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<tr>
<td>CE5002S</td>
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</table>

**Course Outcomes:**
- C01 Able to understand fundamental principles of management and behavioral theories
- C02 Able to analyze what motivates employees and adopt appropriate motivation strategies
- C03 Able to understand the policies of performing functions of management effectively
- C04 Able to implement management strategies in construction organizations

Management
Need, what is it, systems approach, and emergence of management thought, contributions of Fredrick Taylor, Henry Fayol, emergence of behavioral sciences, and that of the modern management thought.

Construction Management
Need, nature of construction industry, scope and functions of construction management

Planning
Planning process, objectives, strategies and policies, making planning effective

Organizing
Nature and purpose, types of organizations, organizational behavior, informal organizations, organizational climate, group decision making, making organizing effective

Staffing
Nature and purpose, selection, appraisal, organizational development

Leading
Managing and human factor, motivation, leadership, team development, communication, managing conflicts, qualities of project manager

Controlling
Process of controlling, direct and indirect control.

**References:**
- Koontz, O'Donnel & Weihrich, Management, McGraw Hill
- Dharwadkar P P, Management in Construction Industry, Oxford & IBH
- Luthans, Organization Behavior, McGraw Hill
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tr>
<td>CE5003T</td>
<td>Advanced Materials &amp; Construction Techniques</td>
<td>3 0 0  3</td>
<td>20</td>
<td>60</td>
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</tbody>
</table>

**Course Outcome:**

- C01 Able to develop skills of choosing the appropriate construction technique for a particular construction project.
- C02 Able to develop skills of choosing the appropriate construction materials for a particular construction project.
- C03 Able to prepare method statements for large and heavy construction projects.

**Method statement for large and heavy Engineering projects:**
Method statement for major activities like excavation, concreting, steel fabrication and erection for projects like earthen dams, tunnels, composite structure hydropower projects, nuclear power plant, refineries and other industrial projects like cooling tower, silos, and Chimney

**Concrete construction for heavy Engineering projects:**
Selection of equipments for batching, mixing, transporting, placing and compacting for various types of jobs, safety measures during concreting, special concretes and mortars, preplaced aggregate concrete, roller compacted concrete, concreting under water, concreting in different weather condition.

**Prefabricated Construction:**
Planning for pre-casting, selection of equipment for fabrication, transport and erection, quality measures, safety measure during erection.

**Steel Construction:**
Planning for field operation, selection of equipment and erection tools and methods of welding, tools and methods of cutting and joining, safety measures during fabrication and erection.

**Bridge Construction:** Launching of bridges by incremental launching, using false work, and balanced cantilever construction method.

**Ground Improvement Techniques:**
Soil distribution in India, Reclaimed Soils, selection for field compaction procedures, compaction quality control, stone column, sand drain, diaphragm wall, soil reinforcement, thermal methods, improving rock stability and quality.

**Formwork:**
Requirement of formwork, loads carried by formwork, types of formwork such as timber formwork, Steel formwork, patent formwork, modular shuttering, slip forms, steel scaffolding.

**Intelligent Buildings:**
Historical Context, High technology: - Energy efficiency, life safety systems, Telecommunications systems, workplace automation and typical services.

**Construction Materials:**
Study Of Advance Building Materials like, aluminum, glass, fabric, various types of finishes &treatments, Construction chemicals – sealants, engineering grouts, mortars, admixtures and adhesives
Course Outcomes:

C01 Able to prepare project plans, resolve resource conflicts & to understand time cost tradeoff principles
C02 Able to interpret progress data, perform variance analysis and suggest control measures
C03 Able to identify risks and safety issues on projects and to define risk and safety management policy
C04 Able to design information system for managing projects

Project management: scope and framework, agencies involved, their relationships and scope

Reference Books:

- Thomas Baron, Erection of steel structures
- Stubbs, handbook of heavy Construction
- Mahesh Verma, Construction Equipment and its planning & applications
- R.L. Purify & Ledbetter, Construction Equipment and planning, McGraw Hill
- Wadell, Concrete Construction Handbook
- Dr. P. Purushothamma Raj, Ground Improvement Techniques, Laxmi Publications Punnoswami, Bridge Construction
- Journals of Civil Engineering and Construction Engineering

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>L-T-P (Hours/Week)</th>
<th>Credit</th>
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<tr>
<td>CE5004T</td>
<td>Advanced Project Management</td>
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<td>3</td>
<td>20</td>
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</table>
Project Planning: Plan development process, precedence diagrams with overlapping relationships, network analysis, master network and sub-nets, time scaled networks

Resource scheduling: resource aggregation, allocation, concept of leveling and smoothening, line of balance, float factor, issues involved in multi project multi resource scheduling, time-cost tradeoff: simple and complex

Project monitoring: progress reporting, alarm reports, review meetings, updating plans

Project control: control system framework, baselines, scope, time, cost & quality control systems, codification

Safety: common causes of accidents, occupational health hazards, general measures to ensure safety and safe environment

Risk management: project risks, tools of assessment and methods of mitigation

Information systems: PMIS, integrated approach

Text books
- Chitkara K K, Construction Project Management, Tata McGraw Hill
- Harris R B, Precedence & arrow networking techniques for construction, John Wiley
- Harold Kerzner, Project management, CBS Publishers

References
- King & Hudson, Construction Hazard and Safety Handbook, Butterworths
- P K Joy, Handbook of Construction Management
- James O’Brien, CPM in construction management, McGraw Hill

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Course Outcomes:
- C01 An ability to perform quantity and cost estimates of Civil Engineering Projects.
- C02 An ability to draft and prepare construction documents, such as specifications, bill of quantities, contracts and construction schedules.

Detailed estimation of quantities, preparation of detailed estimates, and use of provisional sums, day works and contingencies in the estimate form architectural and working RCC drawings of a
structure.

For estimation, structures such as high rise buildings, flyovers, bridges, commercial structures, industrial structures may be considered.

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Course Outcome:
- C01 Able to prepare the activity logic (sequencing)
- C02 Able to prepare plans and schedules using appropriate tools like bar chart, line of balance, time chainage chart, network etc.
- C03 Able to analyse networks using suitable software / manually.

The course shall include Assignments to cover
- Preparation of plans for construction of a facility with different levels of detail, (broad and detailed ones) for use of persons at different levels in an organization
- Demonstration of use of a software application to develop plans and develop schedules

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<th>Course Code</th>
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<tr>
<td>CE5003P</td>
<td>Sampling &amp; Testing of Materials</td>
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Course Outcomes:
- C01 Able to understand sampling techniques for various construction materials for testing
- C02 Able to determine the properties of sand, bricks, steel, bitumen and ingredients of concrete etc.
- C03 Able to design a mix for required grade of concrete and/or bituminous mixes.

Study of Standards to understand procedures for sampling and testing of key construction materials and record keeping thereof.
Performing laboratory tests on such materials with the use of conventional / advanced testing facilities.
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<td>CE5006S</td>
<td>Research Methodology</td>
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**Course Outcomes:**
- CO1. Be able to conduct disciplined research under supervision
- CO2. Be able to critically evaluate current research and propose possible alternate directions for further work
- CO3. Be able to develop hypothesis and methodology for research
- CO4. Be able to communicate scientific results clearly for peer review

**Introduction:**
Meaning and purpose of research, objectives of research, types of research, significance of research, Research Approaches, Research Methods v/s Methodology, Research Process, Criteria of Good Research. Research and Scientific Methods

**Research Problem:**
Steps in Research: Identification, selection and formulation of research problem- Research questions-Research design- Formulation of hypothesis- Review of literature. Definition, necessity and techniques of defining research problem; Formulation of research problem; Objectives of research problem.

**Research Design:**
Need and features of good research design. Types of Research Designs, Basic Principles of Experimental Designs; Design of experiments.

**Data Collection:**

**Sampling Design:**
Sampling theory-Types of sampling-Steps in sampling-Sampling and Non-sampling error- Sample size –Advantages and limitations of sampling. Census and Sample surveys, Different types of sample designs, characteristics of good sample design. Techniques of selecting a random sample.

**Hypothesis Testing:**

**Technical Paper and Report Writing:**
Basic concepts of paper writing and report writing, review of literature, Concepts of Bibliography and References, significance of report writing, steps of report writing, Types of Research reports, Methods of presentation of report.
### Structuring the Report:
Types of reports, Contents, Styles of reporting, Steps in drafting reports, Chapter format, Pagination, Identification, Using quotations, Presenting footnotes – abbreviations, Presentation of tables and figures, Referencing, Documentation, Use and format of appendices- Indexing Editing and evaluating the final draft.

### Research ethics:
Ethical Issues, Ethical Principles that govern Research, Ethically valid Information Sources, Regulatory Compliance.

### Reference Books:
- Design and Analysis of Experiments, Montgomery D.C. John Wiley, 2001
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**Course outcomes:**
- C01 Able to prepare inventory analysis and make material purchase decisions.
- C02 Able to plan and monitor for equipments and material requirements and use.
- C03 Able to manage Human resources effectively and efficiently.

**Human Resources Management**
Staffing, recruiting, orientation and training, performance evaluating, merit rating
Labour Management: Strikes and lockouts, collective bargaining, grievances and grievance settling procedure, labour welfare

**Equipment Management**
Mechanization on construction projects, selection of major and minor equipment, production estimating, sizing and matching of equipment
Sources of construction equipment: purchase, rent and lease, old and new equipment
Economics of equipment, useful / economic life of equipment, equipment operation and service, maintenance, depreciation, obsolescence and replacement
Equipment management systems, organizations, record keeping, training to operators

**Materials Management**
Importance, estimation of materials, Classification and codification, ABCanalysis
Purchase function: legal aspects of purchase, inventory control, concept of EOQ
Stores management, minimizing wastage
Material management systems, Organizations, record keeping

**References:**
Varma Mahesh, Construction Equipment, its Planning & Application, Metropolitan & Co
Gopalkrishnan, Materials Management
Nunnally, Managing construction equipment, Prentice Hall
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<td>CE5008S</td>
<td>Construction Contract Management</td>
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**Course Outcomes**
- C01 Able to understand legal issues faced by the construction agencies.
- C02 Able to analyze trade union problems, workers’ problems in view of legal provisions.
- C03 Able to analyze the Contract conditions and their impact on project execution.

**Forms of contracts**
Evolution of construction contracts – EPC contracts and various forms of PPP, Service Contracts and Management contracts, Lease Contracts, Concessions, Annuity, Critical comparison, bid cycle, standard tender documents. FIDIC. Ethical responsibilities, Guidelines for tendering prepared by Government agencies

**Forms of Entities, establishment and their liabilities**

**Indian Contract Act**

**Contract administration**
Deviations and extras, claims and their management, disputes, care to be taken to avoid disputes and protect rights, dispute resolution methods, Arbitration and Reconciliation Act

**Laws applicable to construction activity**
Need and broad provisions of:
Environment Laws, Heritage laws, Industrial Disputes Act, Workmen's Compensation Act, Employer's Liability Act, Payment of wages Act, Contract Labour Act, Minimum Wages Act, Inter-state Migrant workers act and other acts introduced from time to time

**References:**
- Patil B S, Legal Aspects of Building & Engineering Contracts
- Gajaria, Indian contract Act
- Fisk E R, Construction Project Administration, Wiley
- All referred bare Acts, Model Concession Agreement, FIDIC Documents Standard contract documents used by various Government agencies
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**Course Outcomes:**
- CO1. Be able to prepare cost estimates and bids
- CO2. Be able to develop reporting system to track & monitor costs
- CO3. Be able to make decisions to organize finance and to control costs

- Cost engineering for construction agencies
- Cost estimates: approximate and detailed
- Proposals and bids preparation
- Construction financing, breakeven, profit and cash flow analysis
- Capital budgeting
- Cost analysis table, network based cost control
- Contractor’s cost control on various types of contracts
- Owner’s cost control on various types of contracts
- Cost accounting concepts

**Text Books**
- Successful construction cost control, HiraAhuja, Wiley
- Construction cost control, Roy Pilcher, Blackwell Publishers
## Course Outcome:

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CO1. Be able to prepare quick and detailed cost estimates for civil engineering facilities
CO2. Be able to design information system for tracking cost data
CO3. Be able to present cost data and to draw inferences based on cost data

The laboratory shall include Assignments to cover:
- Preparation of different types of estimates for construction of a facility based on available details
- Preparation of budgets
- Demonstration of use of a software application to monitor budgets and actual expenditure

## Course Outcome:

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CO1. Able to prepare list of activities, logical sequence and preparation of plans
CO2. Able to Prepare plans and schedules of construction activity using project management software
CO3. Use of software to develop applications on cash flow generation, resource planning etc.

Laboratory work to include:
- Simulation to develop issues involved in bidding, bid evaluation, plan preparation, monitoring & control
- Use of project management software to develop a plan with overlapping relationships.
- Application of general purpose software for project management functions like: Cash Flow generation, Resource leveling, Updating of networks, Variance analysis etc.
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<td>CE5011L</td>
<td>Building Information modeling</td>
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**Course outcome:**
- **CO1.** Able to understand the modeling concept of building information
- **CO2.** Able to carryout the planning, design, construction and operation by using suitable BIM software

**Study and application of:**
Building information modeling concept throughout the building life cycle
For planning, design, construction, operations and maintenance

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<td>CE5801D</td>
<td>Technical Seminar</td>
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**Course Outcomes:**
- **CO1.** Able to understand content and to summarize published research articles
- **CO2.** Able to prepare a concise report and give presentation on specific topic

**Student is expected to study at least two research papers on a relevant topic published in referred journals.**
**Student should prepare a summary report providing background information from the topic and the contents of the research papers.**
**Student has to present the report in an open seminar.**
**Student may also be required to visit a construction site, study ongoing construction activities, prepare a detail report and present the same in an open seminar.**
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<td>CE5101S</td>
<td>Risk &amp; Value Management</td>
<td>3 1 0</td>
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**Course Outcomes**
- CO1. Able to conduct value management and risk analysis exercise
- CO2. Able to predict life cycle costs
- CO3. Able to gather requirements and generate alternatives to satisfy needs
- CO4. Able to determine appropriate risk response

Value engineering introduction, definitions: Value, value engineering, value analysis, value management, Habits, Roadblocks & attitudes and their relation to value engineering

Function Analysis: Function & its role in achieving value, function in terms of its cost & worth, Graphical function analysis, function analysis system technique

Creative thinking: creative people, creative processes, conducting creative session

Life cycle costing: purpose & implications, economic principles for life cycle costing, types of life cycle costs.

Risks: risks in construction, risk management framework

Risk identification: sources of risk, risk classification, risk effects, common tools and techniques of identification

Risk analysis: risk measurement, qualitative and quantitative techniques

Risk response: risk management plan, risk retention, risk reduction, risk transfer, risk avoidance, attitudes towards risk

Risks in construction projects: money, time and technical risks, contracts and risks, risks in the context of global project teams

References:
- Value engineering, Larry Zimmerman, Glen Hart, VanNostrand Reinhold Co
- Techniques of value analysis & engineering, Lawrence Miles, McGraw Hill book Co
- Risk management & construction, R Flanagan & G Norman, Wiley-Blackwell
- Practical risk management in construction industry, Leslie Edwards, Thomas Telford
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<th>Course Code</th>
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<td>CE5102S</td>
<td>Managerial Decision Making</td>
<td>3 1 0</td>
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**Course Outcomes**

- CO1. Able to identify and formulate problems and identify suitable technique to solve the problem
- CO2. Able to apply linear programming, network models, dynamic programming and simulation tools
- CO3. Able to understand decision theories and issues involved in group decision making

**Management Decision Making**

Management decision making, art of modeling, systems approach, concept of optimization, attitudes of decision maker

**Linear programming**

LP formulation, solution by graphical method, simplex method, duality, sensitivity and parametric analysis, transportation model, assignment model, Integer programming - branch and bound algorithm

**Network model**

Network definition, shortest route problem, maximal flow problem

**Waiting Lines**

Basic structure of queuing models, M/M/1 model

**Dynamic programming**

Formulation of model and recursive equations, and applications

**Group decision making**

Behavior of a decision maker as an individual and in a group, compromise and consensus decision making

**Decision theory and games**

Decisions under uncertainty and risk: decision trees, game theory

**Simulation**

Monte Carlo method, applications

**References:**

- Shrivastava, Shenoy & Sharma, Quantitative Techniques for Managerial Decisions, Wiley
- Taha Hamdy, Operations Research, An Introduction
- Rao S S, Optimization: Theory and applications
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<tr>
<td>CE5103S</td>
<td>EIA and Audit</td>
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**Course Outcome:**

- CO1. Understanding of EIA processes and various Government notifications
- CO2. Understanding of the methodology for prediction and assessment of various impacts on environment
- CO3. Ability to apply various methods of environmental audit

1. **Fundamental Approach To EIA:**
   - History of EIA: Evolution Environmental Laws in World & India, Development of EIA in India, Environmental Clearance Procedure in India.
   - Basic Concept of EIA: Introduction, EIA Procedure, Objective of EIA, Significances


3. **Prediction and assessment of impacts on soil and ground water environment:** introduction, soils and ground water, methodology for the prediction and assessment of impacts on soil and groundwater.


5. **Prediction and Assessment of Impacts on Biological Environment:** Introduction, General Methodology for the Assessment of Impacts on Biological Environment, Systematic Approach for Evaluating Biological Impacts.

6. **Prediction and assessment of impacts on the air environment:** introduction, a generalized approach for assessment of air pollution impact.


8. **Prediction and Assessment of Impacts on the Socio-Economic Environment:** Introduction, Social Assessment, Conceptual Frame Work for Socio Economic Assessment.


11. **Rapid EIA:** Introduction, Procedure, Advantages and Limitation.
## 12. Environmental Audit: Aims & Objective, Audit Principles, Partial Environmental Audits, Scope of Auditing, Case Studies

**Recommended books:**

- Environmental Impact Assessment, Lauren David P., Willy Interscience, New Jersey.
- Environmental Impacts of Industrial & Mining activities, Lalit N. Patraik, Ashish Public house.
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<td>CE5104S</td>
<td>Environmental Management</td>
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**Course Outcomes:**

1. CO1. To understand the basics of Environmental Management.
2. CO2. To understand and be able to apply concepts of sustainability, local and global environmental issues and its management.
3. CO3. Able to develop preventive and reactive strategies for pollution control as applicable in present context.
4. CO4. Able to prepare EMP of a project / industry.


Environmental Policy Analysis- Macro level and Micro level, Methods of Policy Analysis, steps involved, Environmental Management Plan (EMP), Components of EMP, Preparation of EMP, Case Study


Environmental Legislation, Air, Water and Environmental acts., Preventive and reactive strategies for environmental pollution control, Environmental organization for planning and implementation, sustainable development.

Organization for Environmental Management, Organizational Design, Institutionalization of Environmental management in India, Ministry of Environment and Forest, Central Pollution Control Boards, State Pollution Control Boards, Local Bodies, their scopes, Organizational and Functional issues, Related Issues in Environmental Management.

**Recommended books:**

- Assessment and analysis of Environmental management, Shukla S. S., Shrivastva P. R. 1992, commonwealth publishers New Delhi 2003
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Course Outcomes:

1. Able to indentify various types of distress in concrete structures.
2. Able to identify the effects due to climate, temperature, chemicals, wear and erosion on structures.
3. Able to analyze the failures in structure.
4. Able to make recommendations regarding appropriate materials and techniques for repairs.

Infrastructure management: Need and concept, expected performance, survey and evaluation of distresses, inspection checklists, organization for rehabilitation, policies, funding.

Concept of infrastructure upkeep

Buildings: Post occupancy evaluation of buildings, deformation and common defects in buildings, restoration & rehabilitation measures.

Pipelines (water/ sewage/ air/ gas): Purpose and methods of evaluation, evaluation of physical condition, methods of rehabilitation.

Pavements (roadways / runways): Evaluation and performance surveys, distress evaluation, methods of resurfacing, overlays, restoring and rehabilitation, up-gradation and maintenance of permanent way.

Bridges: Inspection and reporting methods, rehabilitation measures.

Ports & harbors: Maintenance of ports, port buildings, and services.

References:

- Published books in the relevant areas to be supplemented by latest journal articles and papers, seminar and conference proceedings, in-house publications, monographs etc.
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<td>CE5106S</td>
<td>Energy conservation in facility design &amp; construction</td>
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**Course Outcomes:**
- C01 Able to do analysis of energy requirements for buildings
- C02 Able to do the planning of energy efficient building and landscaping.
- C03 Able to perform the thermal Analysis and design energy efficient building for human comfort

**Importance of Energy in City Planning**

**Energy Conservation**
Thermal Analysis And Design For Human Comfort, Thermal comfort; Criteria and various parameters; Psychometric chart; Thermal indices, climate and comfort zones; Concept of sol-air temperature and its significance; Energy and resource conservation-Principles, Design of green buildings-rating systems-LEEDStandards-GRIHA standards, Evaluation Tools for Building Energy-Embodied and Operating Energy-Peak demand-Comfort and Indoor Air Quality-Energy Efficient Design Strategies-Contextual factors-Heat Transmission In Buildings-Surface coefficient: air cavity, internal and external surfaces, overall thermal transmittance, wall and windows; Heat transfer due to ventilation/infiltration, internal heat transfer; Solar temperature; Decrement factor; Phase lag. Design of daylighting; Estimation of building loads: Steady state method, network method, numerical method, correlations; Computerpackages for carrying out thermal design of buildings and predicting performance.

**Energy Efficiency**
Energy in Building Design-Energy Efficient and Environmental Friendly Building- Climate, Sun and solar radiation-Psychometrics-Passive Heating and Cooling Systems- Analysis of results-Identification of wastage-Priority of conservative measures-Maintenance of Energy Management - Calculation of instantaneous heat gain through building envelope; Calculation of solar radiation on buildings; building orientation; Introduction to design of shading devices; Overhangs; Factors that affect energy use in buildings; Ventilation and its significance; Air-conditioning systems; Energy conservation techniques in air-conditioning systems Application of wind, water and earth for cooling; Shading, paints and cavity walls for cooling; Roof radiation traps; Earth air-tunnel

**Energy Management**
Energy management concept in building, Bioclimatic classification of India; Passive concepts appropriate for the various climatic zones in India; Typical design of selected buildings in various climatic zones; Thumb rules for design of buildings and building codes. Energy Efficient Landscape Design Modification of microclimatic through landscape element for energy

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<td>Operational Health &amp; Safety management</td>
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**Course outcomes:**
- C01: Able to work as safety engineer in construction industry
- C02: Able to determine safety practices necessary for a project site and to develop safety plan
- C03: Able to make aware about the hazards, causes of accidents to the site employees.

Hazards and causes of accidents, safety measures
Safety legislation and standards for construction industry
Safety precautions and practices in various construction activities like excavation, concreting, scaffold erection and dismantle, concreting, steel erection and demolition of structures
Occupational hazards and personal protective equipment
Management of accidents
Organization for safety, site management, safety manual and check lists
Safety officer, safety committee, safety training, safety audit

**References:**
- Safety and Health in Construction, ILO, 1992
- Construction hazard & Safety handbook, R Hudson and R W King, Butterworths

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**Course outcome**
- CO1: Able to prepare and evaluate contract bids and
- CO2: Able to understand risks in construction business
- CO3: Able to maintain appropriate and necessary records
Indian construction industry
Projects, Unique features of construction, project participants, methods of project execution

Construction economics
Economic decision making, time value of money, evaluating alternatives,
Investment criteria: Net present value, benefit cost ratio, internal rate of return.

Construction contract
Types of contract, Contract document, Bidding process, General contract conditions (CPWD and FIDIC), sub-contracting, claims, disputes and project closure

Bidding: Estimation of costs and bidding strategies, bid preparation, bidding models

Project organization
Forms of business organization, structure of construction organization, organization for project management, management levels

Planning and organizing construction site and resources:
Site: site layout, developing site organization, record keeping at site, Manpower: planning, organizing, staffing, motivation, Materials: concepts of planning, procurement and inventory control, Equipment: basic concepts of planning and organizing.

Construction accounts: Accounting process, revenue recognition, working capital needs, financing for working capital, Funds: cash flow, sources of funds

Risks in construction, Risk management process, insurance in construction

Safety and health on project sites, Accidents; their causes and effects, costs of accidents, organizing for safety and health

**Text Books:**
- Jha K N, Construction Project Management, Pearson, 2011
- Chitkara K K, Construction Project Management, Tata McGraw Hill

**Reference Books:**
Course Code | Course Title | L-T-P (Hours/Week) | Credit | TA | IST | ESE | ESE hours
--- | --- | --- | --- | --- | --- | --- | ---
CE5109S | Integrated GIS & GPS in Infrastructure | 3 0 0 | 3 | 20 | 20 | 60 | 3

Course Outcomes:
CO1. Able to analyze spatially referenced data using scientific method to address an inquiry based study
CO2. Able to acquire and create spatial data from satellite imagery, printed maps, online sources, &GPS
CO3. Able to develop spatial and temporal models for presentation, analysis and decision-making
CO4. To achieve competency in the use of the GIS software packages
CO5. Able to design and execute a workflow GIS techniques appropriate to an applied field

Geographical Information System (GIS):
Information systems, spatial and non-spatial information, geographical concept and terminology, advantages of GIS, Basic component of GIS
Commercially available GIS hardware and Software
Field data, statistical data, maps, aerial Photographs, satellite data, points, lines, and areas features, vector and raster data, data entry through keyboard, digitizer and scanners, preprocessing of data rectification and registration, interpolation techniques

Global Positioning System (G.P.S)
G.P.S. Segments: Spaces Segment, Control Segment, User Segment
Features of G.P.S. Satellites, Principle of Operation
G.P.S. Receivers: Navigational Receivers, Surveying Receivers, Geodetic Receivers,
Computation of Co-ordinates:- Transformation from Global to Local Datum, Geodetic Coordinates to map co-ordinates, G.P.S. Heights and mean sea level Heights
Applications of G.P.S.

Civil Infrastructure Management:
Introduction, Infrastructure Life Cycle, Challenges of Infrastructure Management, meeting the challenges, Infrastructure Management services tier, GIS based civil Infrastructure management.

Case Studies:

i. GIS based management approach for Transportation Infrastructure Construction
ii. Application of GIS in Transportation
iii. GIS based applications in Airfield Infrastructure system management and maintenance
iv. Developing Enterprise GIS based data repositories for Municipal Infrastructure asset management
v. GIS based decision support system for optimal renewal planning of sewers
vi. GIS based integrated infrastructure Management
vii. GIS based technologies for watershed management
viii. Single frequency GPS for Bridge deflection monitoring: progress and results
ix. Monitoring of rigid structures using GPS and RTS – Experiment
x. Real-time bridge health monitoring for management
xi. Deformation studies of Koyana Dam, Western India using GPS.
xii. GIS based Land record management

Reference Books:-
- Introduction to Geographical Information System, Kang-tsung Chang, Tata McGraw Hill
- International and National Journals on GIS and GPS

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<tr>
<td>CE5110S</td>
<td>Water Resource management</td>
<td>3 0 0</td>
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Course Outcomes:
CO1. Skill of choosing the correct management techniques for water resources.
CO2. Ability to identify and define problems, gather data, generate and prioritize a set of
alternative solutions, and select and implement the best alternative.

CO3. Ability to apply the principles of remote sensing and GIS to the water resources for management.


2. Watershed Management techniques: Rain water harvesting, On-site and off-site management structures for soil and water conservation. Community Watershed Management

3. Surface flow modeling techniques: Hydrological and hydraulics flow model, Reservoir routing, channel routing, general operation of flood forecasting, forecasting methods adopted in India, forecasting by unit hydrograph method, Numerical modeling


5. Linear Programming and Dynamic Programming Applications, Economics in water resources, Modeling of water resources systems, Constrained and unconstrained optimization, Linear programming with applications to reservoir sizing, reservoir operation, Dynamic programming with applications to water allocation, capacity expansion, reservoir operation.


7. Measurement and Processing of Data: Measurement and Processing of Rainfall Data, Stream flow Data, Meteorological Data, Water Quality Data, Ground Water and Other Data Acquisition and management of spatial data Hydrological databases and Dissemination of Data Statistical Analysis of Data: Regression, Correlation and Data Generation

Recommended books:
- Water Resource Engineering by Ralph A Wurbs and Wesley P James, PHI Learning Private Ltd, New Delhi, 2009

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<td>CE5111S</td>
<td>Construction management information systems</td>
<td>3 0 0</td>
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Course Outcomes:

CO1. Able to manage the Information Systems Resources.
**Course Outcomes:**

CO3. Able to develop and administer Database based information systems

<table>
<thead>
<tr>
<th>Decision making and information requirements analysis</th>
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<td>Manual systems versus computerized systems</td>
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<tr>
<td>Design, development and implementation of system</td>
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<td>Automation of construction engineering &amp; management functions</td>
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<tr>
<td>3D visualization of construction processes</td>
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<td>Mobile and modern day communication techniques</td>
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**References:**
- Management information Systems, S Sadgopalan, PHE Learning
- Management information system for the Construction industry, D E Douglas, University of Arkansas

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<td>CE5112S</td>
<td>Facilities management</td>
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**Course Outcomes:**
C01 Able to understand issues involved in facilities management
C02 Able to prepare facilities management plan
C03 Able to carry out facility performance audit.

Types, mechanisms and analyses of deterioration of concrete and steel structures, approaches and means of damage assessment, assessing structural stability and integrity of existing structures, development of sound strategy for repair and restoration. Protection and repair materials, techniques, design and economic aspects.

Introduction to built facility management
Need, functional planning, workspace ecology, worker productivity, space planning, needs analysis

Property maintenance
Maintenance planning, support services, obsolescence and refurbishment, outsourcing

Facility performance audit
Premises audit, health & safety, whole life assessment.

Financial aspects
Budgets, budgetary control depreciation.

Disaster recovery plans

MIS for facility management

References:
- Strategic management of built facility; Craig Langston & Rima LaugeKristensen; Butter worth, Heinemann
- Facilities Management - Theory & Practice; E & F N Sons
- Total Facilities Management; Atkins & Book; Blackwell Science

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<tr>
<td>CE5113S</td>
<td>Quality Assurance on Construction Projects</td>
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Course Outcomes:
C01 Able to apply quality control concepts for improving the quality of construction
C02  Able to maintain the records of quality assurance processes and audits.
C03  Able to use statistical tools for better quality control in construction projects.

Introduction: Quality basics and history, Quality advocates, Quality improvement

Concept of Total Quality Management; contributions of Deming, Juran, Crosby

Quality Improvement Techniques: Pareto Diagrams, Cause-Effect Diagrams, Scatter Diagrams, Run Charts, Cause and Effect Diagrams

Statistical Concepts:
Definitions, Measures of Central Tendency, Measure of Dispersion, Concepts of Population and Samples, Normal Curves, Control Charts for Variables, Variation: Common vs. Special Causes
Control Chart Techniques: X-bar and R chart Correlation, X-bar and S charts, Control Chart Interpretation and Analysis, Using Charts to Pinpoint Problems, Other Variable Control Charts, Individuals and Moving Range Charts, Moving Average and Moving Range Charts, Median and Range Charts

Fundamentals of Probability: Basic Concepts and Definitions, Discrete Probability Distributions, Continuous Probability Distributions, Control Charts for Attributes, Control Charts for Non-conforming Units, Control Charts for Counts of Non-conforming Units

Quality Costs: Quality Cost Measurement, Utilizing Quality Costs for Decision-Making

Quality of construction materials and workmanship: Specifications, How to define, standard documents and specifications therein, Evolving Standards, Benchmarking

Quality Function Deployment: Design of Experiments, Quality Systems: ISO 9000, Six sigma, Certification Requirements, and Auditing

References:
- Quality management in construction projects, A R Rumane, CRC Press
- Management of quality in construction, Ashford, Routledge
- Construction inspection handbook: total quality management, James O’Brien, Springer

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<td>CE5114S</td>
<td>Pavement Management System</td>
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Course outcomes:
C01 Skills in selecting appropriate maintenance operations / alternatives of pavements.
C02 Able to plan and design pavement management system.
C03 Able to design new as well as overlay on exiting flexible and rigid pavements
C04 Able to carry out the cost-benefit analysis of pavements projects.

Pavement distresses
Distresses in flexible/rigid pavements causes & remédiés. Visual Surface distress survey procedures and techniques. Serviceability Indicators for roads, Measurement of Serviceability Indicators using various equipments like Bump Indicator, Skid tester, Distress surveys & Benkelman Beam

Maintenance operations/alternatives
Classification of maintenance operations: Routine, Periodic, Special.
Common types of maintenance: Potholes, Cracked surface, Ruts & undulations, Resurfacing, Interface treatments,
Bituminous Thin Surface Courses: Seal Coat, Surface Dressing, Premixed carpet, Mixed seal surfacing, Micro asphalt concrete (MAC), Bituminous Surface Courses: Semi-Dense Bituminous Concrete, Bituminous Concrete, and Bitumen Mastic.
Road maintenance in high rainfall areas. Choice of materials. Modified bitumen & geo-fabrics. Maintenance alternatives including recycling

Pavement Management System (PMS)
Components of PMS and their Activities, Major Steps in Implementing PMS, Inputs, Design, Construction and Maintenance, Rehabilitation and Feedback Systems

Pavement Structural Design and Economic Analysis
Emerging Technology in Pavement Management Systems

References:
- IRC 58-2001, Guidelines for the design of rigid pavements for highways
- Specifications for rural road, Indian Road Congress
- Rural roads manual, Indian Road Congress
- Guidelines for the design of flexible pavements, Indian Road Congress
- IRC 81-1997, Guidelines for strengthening of flexible road pavements using Benkelman beam deflection technique

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<td>CE5115S</td>
<td>Sustainable building construction</td>
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## Course Outcomes

C01 Able to understand the various performance certifications techniques for sustainable construction of buildings

C02 Able to know the national and international standard such as LEED, MEP for sustainable construction of buildings

## Syllabus:

Performance certification techniques for sustainable sites, water efficiency, energy & atmosphere, materials & resources, indoor environmental quality, innovation and design. MEP systems such as ventilation, air conditioning, heating, electrical lighting and building control systems

## Reference book:

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<tr>
<td>CE5116S</td>
<td>International Construction Business</td>
<td>3 0 0</td>
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**Course Outcomes**

- C01 Able to understand the business aspects for international construction business
- C02 Able to know cultural environment of international business.
- C03 Able to assess the nations on different parameters and determine feasibility of entering into international business of construction.

International economy: International political system, economic system, multinationals, features of international trade & investment, national interest in international trade

International payments
International monetary system, balance of international payments, transfer of international payments, foreign exchange rates and their determination

Theories of international trade
Developing countries in the world economy, international differences in technology, policy implications for host countries

Cultural environment of international business
Effect of culture, language, education, religion, value systems on business, impact on management styles in selected countries

Role of Indian construction industry in international business, role of foreign companies in Indian business, some case studies

References:
- International Business, Justin Paul, PHI
- International business-Environment & Operations, Daniels, Radebaugh& Sullivan, Pearson Publications
- International business management, BholanathDutta, Excel Books
- International construction, Mark Mawhiney, Wiley-Blackwell